EPICS Alarm System in Phoebus

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I am developing an EPICS alarm system based on CS-Studio Phoebus. Phoebus will be used for new EPICS system development and will replace the existing applications using ALH for alarms and MEDM for monitoring and control screens. Phoebus will also be used to replace Eclipse-based CS-Studio applications (DSG Note 2021-37).

To develop and test EPICS client applications, a source of EPICS process variables (PVs) is needed. PVs of actual detector signals can used for client development, however the signal levels and signal frequency are usually uncontrollable. In addition, a functioning detector and the supporting hardware to readout the signals is needed.

A reliable and controllable source of PVs without the requirement of a working detector and readout hardware would be a good tool for EPICS client development and testing.

The Phoebus alarm system is an EPICS client application that monitors process variables (PVs) from EPICS Input / Output Controllers (IOCs) for alarm conditions. As part of the Phoebus test system (figure1), I developed an host-based softIOC (DSG Note 2022-06) which functions as a detector signal simulator and also checks for alarm conditions on the PVs generated by the softIOC. The Phoebus alarm system under development is tested (DSG Note 2023-06) by properly reacting to PV alarm conditions generated by the softIOC.

Written as a proof of principle application for the Phoebus alarm test station, this initial softIOC simulates four detector signals. In the next phase of development and testing, the softIOC is being expanded to simulate all of the NPS signal PVs produced from the Hardware Interlock System (HIS) (DSG Note 2021-15).

The first group of simulated NPS detector signals from the HIS to be implemented in the expanded test station softIOC are the crystal array

- **Developing CS-Studio Phoebus based controls, monitoring, and alarm system**

- **Writing program to simulate detector signals via EPICS process variables for developing and testing the alarm system and other Phoebus applications**

thermocouples. In the front of the crystal array, there are 56 thermocouples and another 56 in the back of the array. To simulate these signals, I developed a EPICS database template via the EPICS Visual Database Configuration Tool program (VisualDCT). The template contains a block of EPICS records that are common to the generation of all 112 thermocouples (DSG Note 2022-06). This block of EPICS records is repeated for each thermocouple signal that is simulated.

The use of the database template requires a substitution text file containing the PV data needed to generate the 112 individual thermocouple blocks. At the initial start of the signal simulator softIOC, my application startup script uses the database template and the substitution text file I wrote to form the complete database. Following the database formation, the startup script initializes it and the simulation 112 individual thermocouples begins.

Via the user interface (UI) (Figure 3) the softIOC signal simulator can be set to produce a fixed or a random generated value for each of the independently simulated thermocouple temperatures. The simulated signal range, minimum value, and data scan rate is also adjustable via the UI for each temperature. The output PVs with the simulated temperatures are sent out via EPICS channel access to EPICS clients.

PV name	Crystal	read	HIHI set	HIHI read	HIGH set	HIGH read	LOW set	LOW read	LOLO set	LOLO read	Alarm status	Alarm severity	Scan rate	range [°C]	Min T [°C]	Max T [°C]
hcnps_intlk_cz_t_back	0	21.00	21.00	21.00	20.98	20.98	15.02	15.02	15.00	15.00	HIHI	MAJOR	.1 second	0	21	21.00
	5	20.98	21.00	21.00	20.98	20.98	15.02	15.02	15.00	15.00	HIGH	MINOR	.1 second	0	20.98	20.98
	10	15.02	21.00	21.00	20.98	20.98	15.02	15.02	15.00	15.00	LOW	MINOR	.1 second	0	15.02	15.02
	15	15.00	21.00	21.00	20.98	20.98	15.02	15.02	15.00	15.00	LOLO	MAJOR	.1 second	0	15	15.00
	20	17.77	21.00	21.00	20.98	20.98	15.02	15.02	15.00	15.00	NO_ALARM	NO_ALARM	.1 second	5.94	15.03	20.97
	25	15.43	21.00	21.00	20.98	20.98	15.02	15.02	15.00	15.00	NO_ALARM	NO_ALARM	.1 second	5.94	15.03	20.97

FIG.3. Alarm Test Station SoftIOC Signal Simulator User Interface

Via the UI, individual EPICS alarm limits can be set for each temperature output PV. When the PV record is scanned, the EPICS alarm limits is compared with the PV value. If the PV value is outside of the limits, the alarm status and alarm severity is are sent out via EPICS channel access to EPICS clients. The Phoebus alarm system under development uses the simulated thermocouple temperatures and the PV alarm status and severity for testing (DSG Note 2023-06) .
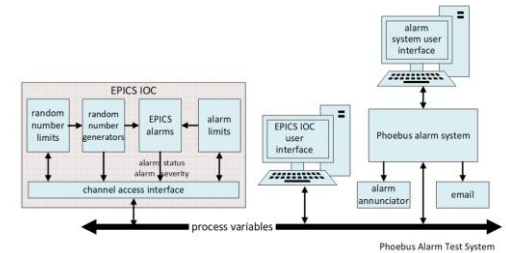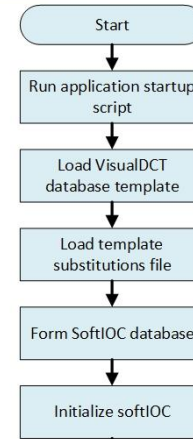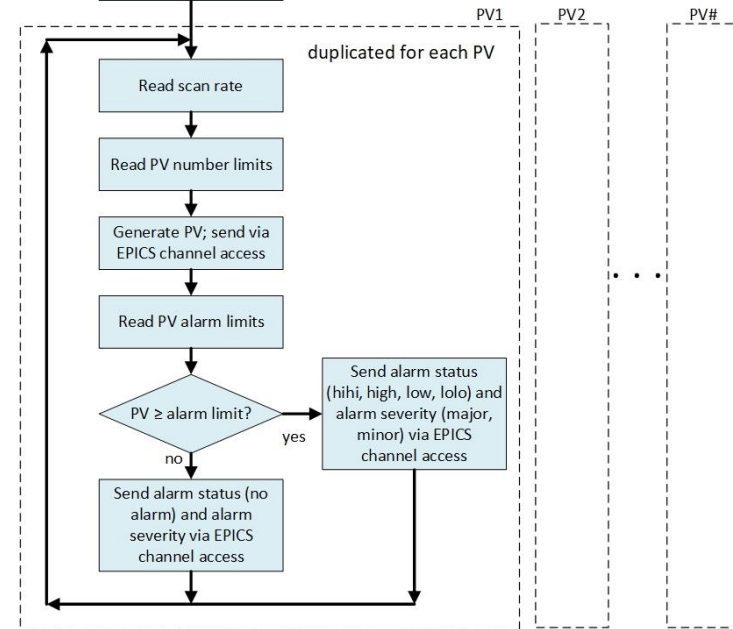

FIG.1. Phoebus Alarm Test Station

Alarm Test Station NPS Simulator
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FIG.2. Alarm Test Station Signal Simulator Flowchart